

# Potential Material Sources for Board Products: Used Pallets and Wastewood at Landfills

Philip A. Araman

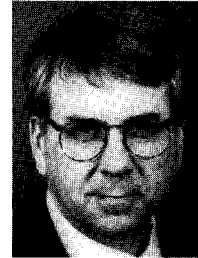
Southern Research Sta., USDA Forest Serv., Brooks Forest Prod. Center,  
Virginia Tech, Blacksburg, Virginia

Robert J. Bush

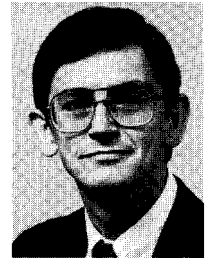
Center for Forest Products Marketing and Management, Dept. Wood Sci.  
and Forest Prod., Virginia Tech., Blacksburg, Virginia

Vijay S. Reddy

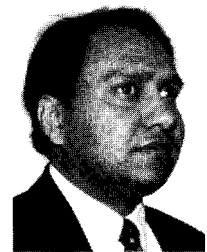
Keystone Veneers, Inc., Williamsport, Pennsylvania



Araman



Bush



Reddy

---

## Abstract

Millions of tons of pallets and other types of wood waste are being sent to landfills every year. At many landfills wood is or could be reclaimed. One potential use for this material is as furnish for board products. To evaluate the potential to reclaim wood waste for useful products we surveyed municipal solid waste (MSW) and construction and demolition (C&D) landfills to determine the amounts of wood pallets and wood waste that enter these facilities. Wood recovery at the landfills was also estimated.

- Wood waste accounted for 7.3 percent of all types of waste received at MSW facilities and 37.8 percent at C&D facilities in 1995.
- Of the wood waste landfilled, approximately 4.2 million tons was pallet material at MSW facilities, compared to 899 thousand tons at C&D facilities.

- Approximately 38 percent of MSW landfills and 32 percent of C&D landfills operate at least one wood/yard waste processing facility.
- Approximately 880.8 thousand tons of wood pallet material was recovered at MSW facilities compared to 161.9 thousand tons at C&D facilities in 1995.

Recovered pallet material at MSW facilities was used in a variety of ways. Approximately 41 percent of the pallet material was used for fuel. Another 38.4 percent of the pallet material was processed for use as mulch, animal bedding, composting, soil amendment, and material in particleboard.

Pallet material recovered at C&D facilities was also used in a variety of ways. Approximately 38.4 percent of the material was used for fuel. Another 32.6 percent of the pallet material was processed for use as mulch, animal bedding, composting, soil amendment, and material in particleboard.

---

## Introduction

Manufacturers, distributors, and others need pallets to store and move goods. Pallets break and many are repaired, but at some point they are disposed of because they are no longer useful. Some end up in landfills.

Discarded pallets and other wood waste could provide good raw materials for board products. But many questions need to be answered before companies will consider these raw material sources: How much wood waste is sent to landfills? What percentage of the wood waste stream consists of pallets? Can they be recovered? Are any being recovered? Is this trend growing? Are there opportunities to recover more wood? Are there higher value options than present recovery?

To help answer some of these questions, a study was conducted by the Center for Forest Products Marketing and Management in cooperation with the USDA Forest Service Southern Research Station unit, both at Virginia Tech in Blacksburg, Virginia. This study focused on disposal of wood pallets and wood waste at landfills in the United States. This paper provides an overview of the total landfill picture (combined information from the construction and demolition (C&D) landfills and municipal solid waste (MSW) landfills studies). This is one of several industrial tracking studies conducted by the Center for Forest Products Marketing and Management. This study is also part of an overall pallet repair and recycling research program for the Southern Research Station conducted in conjunction with Virginia Tech's Department of Wood Science and Forest Products.

The pallet industry is a huge consumer and recycler of wood. Each year a large number of new wood pallets are manufactured using approximately 40 percent of the hardwood lumber and cants produced in the United States (4.5 billion board feet (BBF) in 1995) and significant portions of softwood lumber and cants (1.8 BBF in 1995). The pallet and container industry also receives a significant quantity of wood pallets for repair or recycling (2.6 BBF in 1995). Prior to our study, however, little information was available regarding the number of pallets reaching U.S. landfills for landfilling "as-is" (i.e., without processing such as grinding) and for recycling.

Our study concentrated on pallet waste received and recovered at MSW and C&D landfills. However, estimates are made of the total quantity of all types

of waste and of wood waste received at these landfills in 1995 as well as recovery of this material.

## Wood Waste and Tipping Fees at Landfills

### C&D Landfills

In 1995, wood waste accounted for 37.8 percent of the total waste received at C&D landfills in the United States. In other words, almost 16 million tons of wood waste went to C&D landfills in 1995. Wood waste includes not only pallets but boxes, dunnage, packaging, yard trimmings, and other nonindustrial wood discards. Landfills in the South received the greatest amounts, approximately 62 percent of the estimated 16 million tons of wood waste. Next, the Midwest region accounted for approximately 30 percent of the total wood waste received in 1995. The Northeast and West regions received the smallest amount of wood waste, 4 percent and 3.9 percent of the total, respectively. However, the regions differed less in terms of the percentage of waste that was wood. Wood waste comprised approximately 46 percent of the waste received in the Midwest, 38.9 in the South, 21.3 in the Northeast, and 18.4 in the West,

Nationwide, the average tipping fee at C&D landfills was \$24.20 per ton. However, tipping fees are quite variable among and even within regions. Landfills in the Northeast region assessed a higher tipping fee (\$49.20/ton) than landfills in any other region. The average tipping fee in the Midwest (\$19.80/ton) was lower than that of any other region. The tipping fees in the South and West were \$22.50 and \$20.60 per ton of waste, respectively. Within a region, tipping fees were almost always lower for pallets delivered for processing rather than landfilling as-is.

### MSW Landfills

In 1995, wood waste accounted for 7.3 percent of the total waste received at MSW landfills in the United States. In other words, 21.4 million tons of wood waste went to MSW landfills in 1995. Landfills in the South received approximately 48 percent of the total. The Western region accounted for approximately 29 percent of the total wood waste received in 1995. The Northeast region received the smallest amount of wood waste, 11.4 percent of the total. There was not much difference between the regions in terms of the percentage of waste that was wood. That is, the wood content at MSW landfills was relatively constant, regardless of the total volume of waste received in the region. Approximately 8 percent of the waste received in the South and 6 percent of waste in

the Midwest was wood. In the West and Northeast regions wood waste accounted for 7.3 percent and 6.6 percent of the total waste received, respectively.

Nationwide, the average tipping fee at MSW landfills was \$32.22 per ton. Again, tipping fees are quite variable between and even within regions. Landfills in the Northeast region assessed a higher tipping fee (\$53.30/ton) than landfills in any other region. The average tipping fee in the West (\$26.40/ton) was lower than that of any other region. The tipping fees in the Midwest and South were \$31.40 and \$29.30 per ton of waste, respectively. As with C&D landfills, some MSW facilities assessed lower tipping fees for pallets received to be recycled at the landfill.

### Wood Pallet Waste

#### C&D Landfills

Are wood pallets accepted at C&D landfills for landfilling as-is? If so, what percentage of landfills accept wood pallets for landfilling as-is? What was the quantity of wood pallets landfilled as-is in 1995?

Currently some 67 percent of C&D landfills accept wood pallets for landfilling. However, almost one-third of C&D landfills have a wood or yard waste facility where pallet waste could be recycled. Table 1 provides the percentage of C&D operations in each region that accepted wood pallets in 1995 for landfilling. In the Northeast, only 49 percent of landfills accepted wood pallets for landfilling. In contrast, almost 71 percent of landfills in the Midwest and South accepted wood pallets for landfilling.

We were also interested in knowing the quantity of wood pallets received at landfills that were actually landfilled. We estimate that, in 1995, approximately 899 thousand tons of pallet material were landfilled at C&D facilities in the United States (Table 2). This equals 2.1 percent of the total C&D waste and 5.6

**Table 1.** — Percentage of 1995 C&D landfills that accepted wood pallets for landfilling as-is and percentage that operated a wood/yard waste recycling facility.

Region	As-is	Recycling
----- ( %) -----		
Midwest	70.8	25.0
Northeast	48.8	46.3
South	70.8	36.4
West	62.7	27.1
United States	67.1	32.4

percent of total C&D wood waste landfilled in the United States. If we assume that each pallet weighs 55 pounds, approximately 32.7 million wood pallets were landfilled at C&D facilities in the United States during 1995.

C&D facilities in the South landfilled the largest quantity of wood pallet material (i.e., 677.5 thousand tons, or 75.4% of the total wood pallet material landfilled in the United States). The Midwest region landfilled the second largest quantity of wood pallet material, 15.2 percent or 136.3 thousand tons.

#### MSW Landfills

Currently some 32 percent of MSW facilities do not accept wood pallets for landfilling. While, over one-third of MSW landfills have a wood or yard waste facility where pallet waste can be processed and/or recycled. Table 3 provides the percentage of landfills

**Table 2.** — Estimated quantity of wood pallet material landfilled in 1995 at C&D facilities in the contiguous United States by region.

Region	Estimated quantity of wood pallet material landfilled (1,000 tons)	Pallet material as a percentage of the total waste landfilled	Pallet material as a percentage of the total wood waste landfilled
----- ( %) -----			
Midwest	136.3	1.3	2.9
Northeast	56.9	1.9	8.9
South	677.5	2.6	6.8
West	28.0	0.8	4.6
United States	898.8	2.1	5.6

**Table 3.** — Percentage of MSW landfills that accepted wood pallets for landfilling as-is and percentage that operated a wood/yard waste processing facility in 1995.

Region	Percentage accepting wood pallets for landfilling as-is	Percentage operating a wood or yard waste processing facility
----- ( %) -----		
Midwest	71.0	30.8
Northeast	55.9	38.2
South	63.6	49.5
West	77.3	27.0
United States	67.9	37.9

that accept wood pallets for landfilling. In the Northeast, only 56 percent of MSW landfills accepted wood pallets for landfilling. In contrast, 77 percent of landfills in the West accepted wood pallets for landfilling.

We estimate that, in 1995, approximately 4.2 million tons of pallet material were landfilled at MSW facilities in the United States (Table 4). This equals 1.4 percent of the total waste and 19.6 percent of total wood waste landfilled at MSW facilities in the United States. If we assume, again, that each pallet weighs 55 pounds, approximately 153 million wood pallets were landfilled at MSW facilities in the United States in 1995.

Municipal solid waste facilities in the South landfilled the largest quantity of wood pallet material: 2.4 million tons or 59 percent of the total wood pallet material landfilled. The Midwest region landfilled the second largest quantity of wood pallet material: 17 percent or approximately 726 thousand tons.

**Table 4.** — Estimated quantity of wood pallet material landfilled at MSW facilities in the contiguous United States by region in 1995.

Region	Estimated quantity of wood pallet material landfilled (1000 tons)	Pallet material as a percentage of total waste landfilled ----- (%) -----	Pallet material as a percentage of the total wood waste landfilled
Midwest	725.6	1.8	29.3
Northeast	290.3	0.8	11.9
South	2,480.6	1.9	24.2
West	700.6	0.8	11.1
United States	4,197.2	1.4	19.6

## Landfill Recycling and Tipping Fees

### C&D Landfills

Almost one-third of C&D landfills operated a wood/yard waste recycling facility and 5.7 percent of C&D facilities indicated that they have plans to operate a wood/yard waste processing facility within the next 2 years. This suggests increasing interest in recycling of wood/yard waste, primarily to save landfill space and secondarily to reuse the wood.

Landfills that have a recycling facility are either banning the landfilling of wood pallets or providing incentives (in terms of lower tipping fees) to bring pallets to the wood recycling facilities. Landfills that have a recycling facility generally charge a higher tipping fee for landfilling wood pallets than for disposing of the pallets at the recycling facility. Among landfills with recycling facilities, the average tipping fee for wood pallets landfilled as-is was \$29.00 per ton while the fee for wood pallets that came to recycling facilities was \$22.20 per ton (Table 5). Landfills in the Western region provide the greatest incentive to recycle pallets, with a tipping fee savings of over \$30 per ton,

### MSW Landfills

Over one-third (37.9%) of the responding MSW landfills operated a wood/yard waste processing facility (Table 3). In addition, over 6 percent of the respondents indicated that they have plans to operate a wood/yard waste processing facility within the next 2 years. As with the C&D operations, there appears to be interest in increasing the recycling of wood/yard waste.

In the United States, the average tipping fee for wood pallets landfilled as-is at MSW facilities was \$34.90 per ton while the fee for wood pallets that

**Table 5.** — Regional mean tipping fees for wood pallets at C&D landfills in the contiguous United States that operated wood/yard waste processing facilities in 1995.

Region	Tipping fee	
	Landfilling as-is	At wood/yard waste processing facility
	----- (\$ / ton) -----	
Midwest	19.70	14.50
Northeast	46.00	33.38
South	27.10	23.77
West	42.60	11.50
United States	29.00	22.20

**Table 6.** — Regional mean tipping fees for wood pallets at MSW landfills in the contiguous United States that operated wood/yard waste processing facilities in 1995.

Region	Tipping fee	
	Landfilling as-is	At wood/yard waste processing facility
	----- (\$ / ton) -----	
Midwest	29.40	19.33
Northeast	57.80	32.46
South	30.70	23.08
West	32.80	22.85
United States	34.90	23.90

came to processing facilities was \$23.90 per ton (Table 6). Landfills in the Northeast region provide the greatest financial incentive to recover pallets in the form of a tipping fee differential of over \$25 per ton.

## Wood Pallets Recovered and Recycled

### C&D Landfills

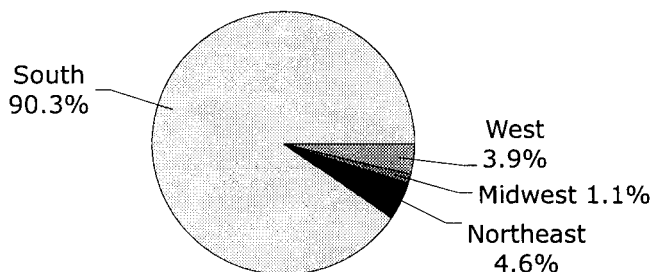
In 1995, 3.8 million tons of wood/yard waste were received for processing (i.e., recovery) at C&D landfill facilities (Fig. 1). Of this total, 161.9 thousand tons (4.3%) were wood pallet material. Again, if we assume that a pallet weighs 55 pounds, 5.9 million pallets were processed at C&D facilities. The Southern region accounted for over 77 percent of this wood pallet material. Figure 2 provides the quantity of wood pallet material processed in each region.

When asked how the volume of wood pallets processed at wood/yard waste facilities has changed over the past 2 years, 19 percent reported an increase and 19 percent indicated a decrease. The average increase was 3.2 percent and the average decrease was 4.2 percent. In addition, 44 percent of the respondents indicated that the volume of pallets received for recycling has not changed over the past 2 years. Approximately 18 percent of the respondents reported that

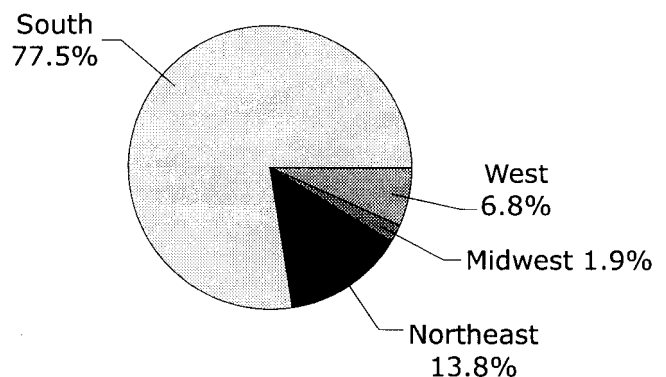
they have been operating the wood/yard waste recycling facility for fewer than 2 years and therefore could not comment on changes.

How was the pallet material used at the processing facilities? Grinding or chipping was the most common process used. Approximately 32.6 percent of the ground or chipped material was used for mulch, animal bedding, compost, soil amendment, and core material for particleboard. Approximately 7.5 percent of the reduced material was used as landfill or road cover. Another 38.4 percent was used for fuel. In addition, 0.9 percent of the pallet material was given away or sold as-is for fuel. In other words, 39.3 percent of the pallet material recovered was used for fuel. Approximately 12.5 percent of the pallet material was given away or sold for reuse as pallets, and 1.1 percent were repaired at the facility for reuse. Figure 3 shows the percentage of pallets landfilled and recovered and the recovery uses.

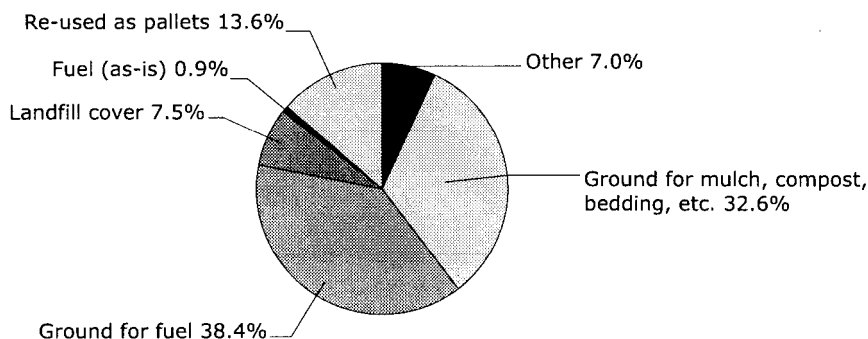
Approximately 69 percent of the recyclers reported that they give away ground or chipped pallet material. Of the respondents who sell ground or chipped pal-



**Figure 1.** — Estimated regional quantity and percentage of wood/yard waste recycled at C&D landfills in 1995.



**Figure 2.** — Estimated regional quantity and percentage of wood pallet material recovered at C&D facilities in 1995.



**Figure 3.** — Landfiling and recovery of pallets at C&D facilities and uses for recovered pallets in 1995.

lets, the average (mean) sale price was \$11.01 per ton and the median sale price was \$10.50.

### MSW Landfills

In 1995, 7.4 million tons of wood/yard waste were received for recycling at landfill processing facilities. Figure 4 provides the quantity of wood/yard waste received for recycling in each region,

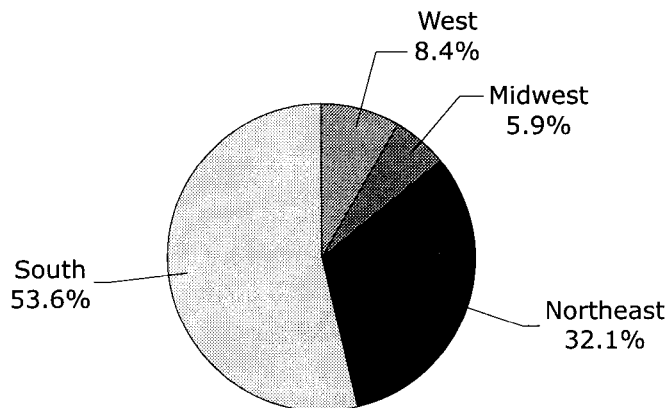
Of the 7.4 million tons of wood/yard waste, 880.8 thousand tons (11.9%) were wood pallet material. Again, if we assume that a pallet weighs 55 pounds, 32 million pallets were received at MSW processing facilities. The Southern region accounted for 60.5 percent of this wood pallet material. Figure 5 provides the quantity of wood pallet material recycled in each region.

When asked how the volume of wood pallets processed at wood/yard waste facilities has changed over the past 2 years, 24 percent of the respondents reported that the volume has increased. The average increase was approximately 8 percent. Almost 16 per-

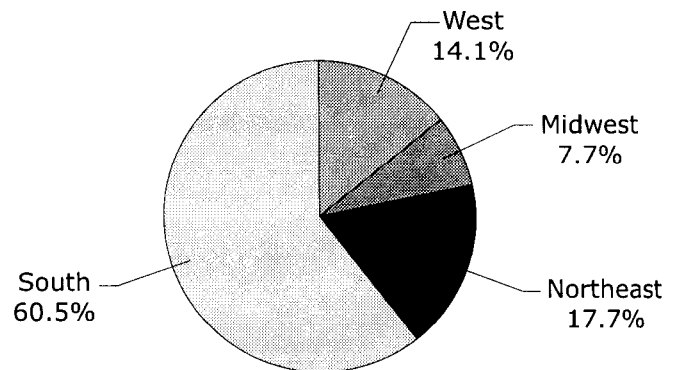
cent of the respondents reported a decrease in volume and the average decrease was 4.3 percent. An additional 48 percent of the respondents indicated that the volume of pallets received for recycling has not changed over the past 2 years and approximately 13.5 percent of the respondents reported that they have been operating the wood/yard waste processing facility for fewer than 2 years.

Grinding or chipping was the most common method of processing the pallet material. Approximately 38 percent of the ground or chipped material was used for mulch, animal bedding, compost, soil amendment, core material for particleboard, and similar uses. Almost 8 percent of the reduced material was used as landfill or road cover and another 34 percent was used for fuel. Approximately 3 percent of the pallet material was reused as pallets. Figure 6 shows the percentage of pallets landfilled and uses for those pallets that are recovered.

Approximately 58 percent of the recyclers reported that they give away ground or chipped pallet material.

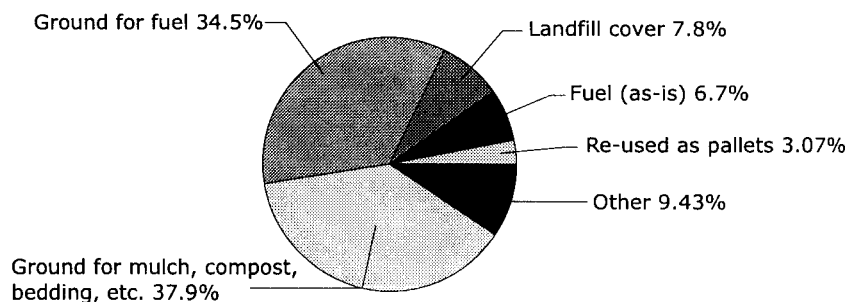


**Figure 4.** — Estimated regional quantity and percentage of wood/yard waste recycled at MSW landfills in 1995.



**Figure 5.** — Estimated regional quantity and percentage of wood pallet material recovered at MSW facilities in 1995.

**Figure 6.** — Percentage of wood pallets landfilled and recovered at MSW facilities and the recovery uses.



Of the respondents who sell ground or chipped pallets, the average (mean) sale price was \$13.17 per ton, and the median sale price was \$10.67.

### **The Total Landfill Picture**

The combined totals of C&D and MSW facilities show that over 223 million pallets (6.14 million tons) passed through landfill gates in 1995. Approximately 17 percent (38 million pallets or 1.04 million tons) were recovered, mainly to little or no revenue products. Landfill operators would likely welcome markets for pallets that would return some or more money to their facilities. Many have grinders and more would likely add grinders if they could be assured of a market for ground pallet material.

There is a large, underutilized source of used pallets at U.S. landfills. This resource could be a good source of material for

- used pallets to repair;
- pallet replacement boards;
- mulch material;
- fuel pellet stock; and
- board products fiber.

### **Summary**

A substantial quantity of wood pallets are entering U.S. landfills each year, thus rendering the valuable resource useless. In total, we estimate that 223.6 million pallets were taken to MSW and C&D landfills in 1995. Only 37.9 million pallets were recovered and not landfilled. The recovery went from low to no revenue uses.

Producers of wood pallet waste believe that it is more cost effective to send the used pallets into landfills than finding a recycler or putting them into use themselves. Incentives could attract more recyclers, such as board products companies, to utilize the currently underutilized wood and pallet material. Arrangements could be made with landfills for special handling, processing, and storage of pallet waste and fiber.

In addition, agencies might provide some incentives for producers of wood pallet waste so that it would be cost effective for them to take the pallets to recycling centers for board products rather than to landfills for landfilling. The end users (recyclers) could also collect tipping fees.